Hazeltine 1400

VIDEO DISPLAY TERMINAL REFERENCE MANUAL

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Hazeltine Corporation
COMPUTER TERMINAL EQUIPMENT
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SAFETY SUMMARY

WARNING

Dangerous voltages (12,000 vdc, 500 vdc and 115 vac) are present in the Video Display Terminal. Some voltage may remain present in monitor circuits after power is removed (see diagram, page 6-3). Use caution when working on internal circuits. Do not work alone.

The terminal power cord should always be unplugged before the cover is removed. Use caution when handling the cathode-ray tube (eg, wear safety goggles) to avoid risk of implosion. The internal phosphor coating is toxic; if the tube breaks and skin or eyes are exposed to phosphor, rinse with cold water water immediately and consult a physician.

This manual is published and distributed by Hazeltine Corporation, Computer Terminal Equipment Product Line. The contents of this manual are subject to change at any time and without prior notice by Hazeltine. The information presented herein may not reflect latest changes in the product. Confirmation and any required clarification of this information can be obtained from your local Hazeltine sales representative.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

APPENDIXES

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

INTRODUCTION

The Hazeltine 1400 Video Display Terminal (also referred to as the Hazeltine 1400) is a product of advanced microprocessor and large scale integrated circuit technology, which offers quiet, reliable and economical operation to the user. The single circuit board design enhances reliability and ease of servicing. Speed, silence, and flexibility, coupled with the operator-oriented features of the Hazeltine 1400 improve the efficiency of both the software and programmer in data input/output operations.

The terminal can also be made compatible with European voltages and frequencies.

This manual describes the operation and features of the Hazeltine 1400. It provides programming and application information for programmers and system designers. If additional technical assistance is needed, contact your Hazeltine representative.

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SECTION 2

INSTALLATION

2.1 SET-UP AND CONNECTIONS

Following unpacking, place the unit so that free air circulates around the rear, base and top. Ensure that cables are free of kinks or right bends.

2.1.1 Interface Connection

The standard Electronic Industries Association (EIA) connector (figure 2-1) located on the rear of the terminal, provides the connection to the data set or acoustic coupler. The interface is compatible with EIA standard RS-232C.

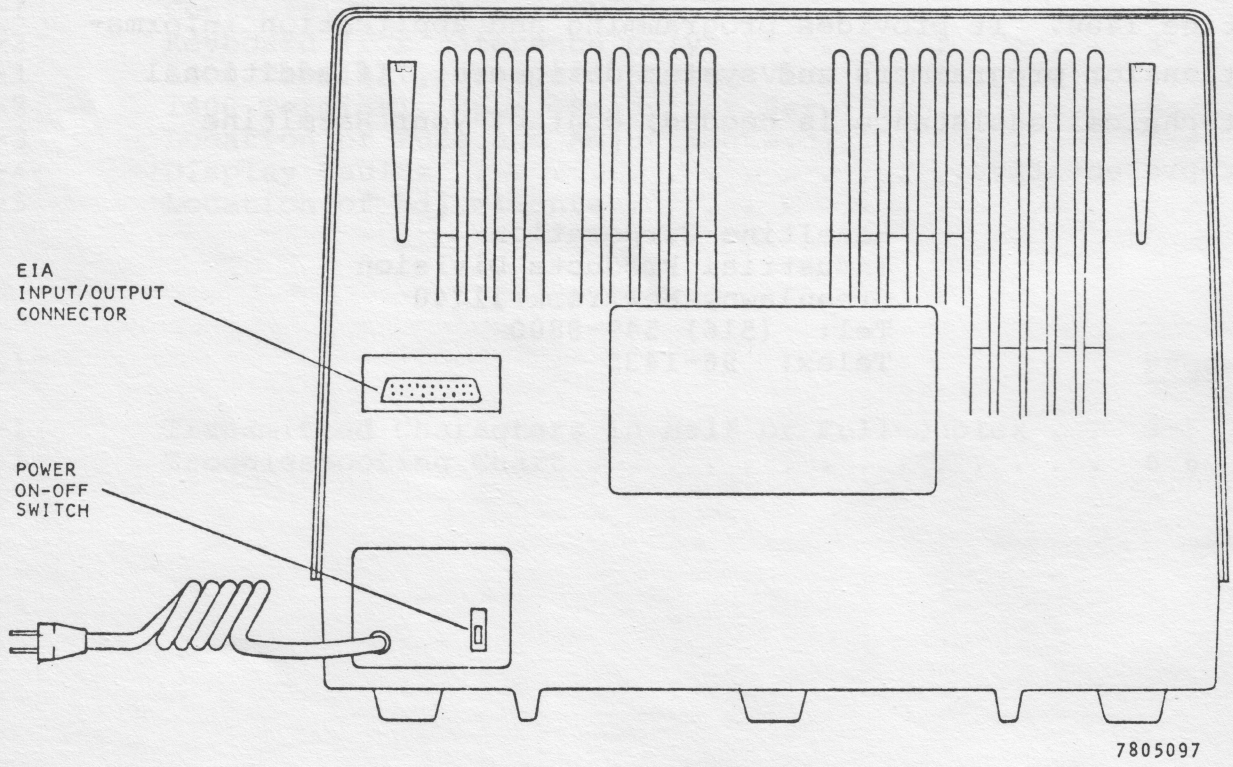


Figure 2-1. H1400 Terminal, Rear View

2.1.2 Power Cord

The power cord must be plugged into a properly grounded power outlet. Do not use adapters which would prevent the terminal unit from being properly grounded.

2.1.3 Cleaning

Dirt and smudges can be removed from the cabinet with any number of common household spray cleaners and a soft cloth. The face-place should be cleaned only with a soft, damp cloth or tissue to avoid scratching.

2.2 TURN-ON AND WARM-UP

A display unit brought in from a substantially colder environment should be allowed at least a one-hour warm-up period to reach room temperature prior to power turn-on.

2.2.1 Power Turn-on

The power on/off switch is located at the rear of the terminal. When power is turned on, the terminal performs a self-test. The appearance of a cursor alone indicates successful completion of the test. If an x appears on the display, it indicates that the self-test has detected a fault.

a. If the display indicates a fault, or if random characters appear on the screen and do not clear when the SHIFT and CLEAR key are depressed, switch power off, wait 15 seconds, and switch power on one more time. If the fault occurs a second time, refer to Section 6.

b. If there is no display after the unit has warmed up for a reasonable time (not more than 3 minutes), adjust the CONTRAST control located under the access panel above the keyboard. If there is still no display, refer to Section 6.

2.2.2 Warm-Up

Allow 30 seconds for display warm-up. At the end of this period the terminal is ready to operate.

SECTION 3

CONTROLS AND KEYBOARD

3.1 INTERFACE SWITCHES AND CONTRAST CONTROL

Six switches used for selecting the input/output interface characteristics of the Hazeltine 1400 are accessible to the operator without having to open the terminal. To gain access to these switches, remove the access panel above the keyboard by pulling up. The panel is held in place by magnets at the edges. The function of each control is described in the following paragraphs.

a. Baud Rate

The three BAUD RATE switches are used to select one of eight communication speeds from 110 to 9600 baud. The switch settings for each available speed are shown in figure 3-1. Figure 3-2 is included for reference only.

b. Parity

The PARITY switches are used to select the parity compatible with the system. The four possibilities are:

Parity	Operation
Odd	Checks for odd parity on received data and generates odd parity on data sent.
Even	Checks for even parity on received data and generates even parity on data sent.
1	The parity bit of each transmitted character is set to a one. No parity check is made on data received.
0	The parity bit of each transmitted character is set to a zero. No parity check is made on data received.

If a character is received with incorrect parity, a question mark (?) will be displayed on the screen. The switch settings for each parity condition are shown in figure 3-1.

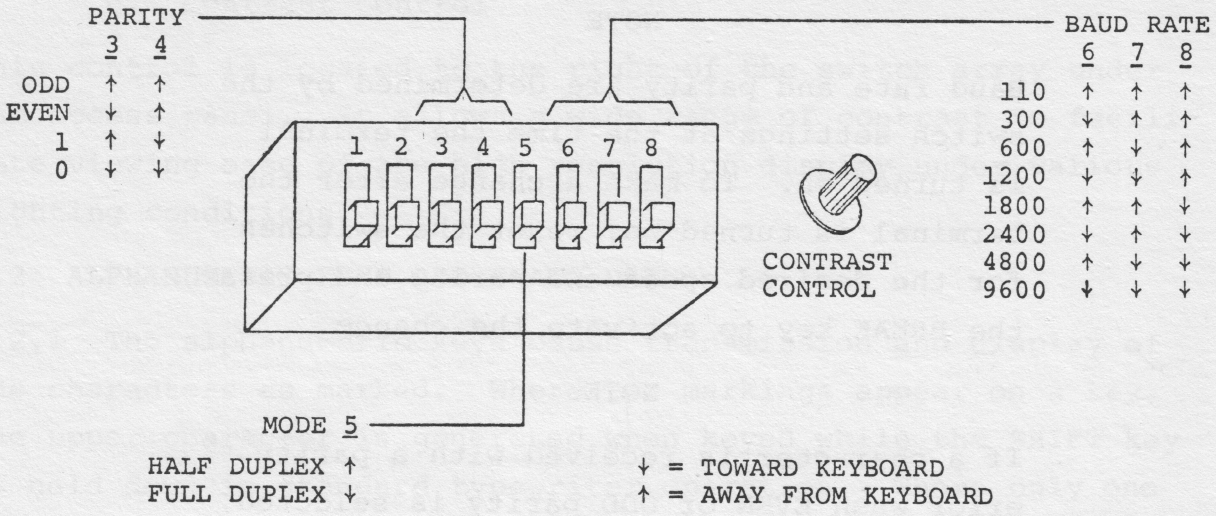


Figure 3-1. Controls Under Access Plate

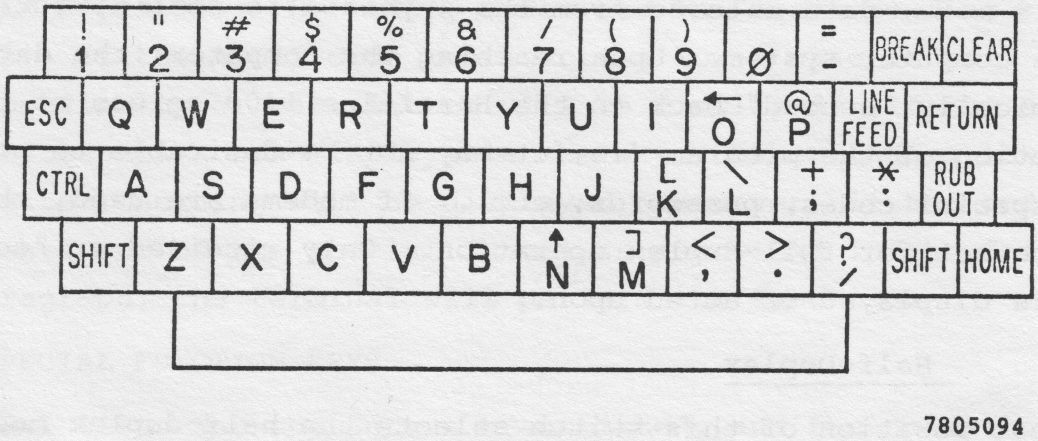


Figure 3-2. Keyboard (for reference only)

NOTE

Baud rate and parity are determined by the switch settings at the time the terminal is turned on. To make a change after the terminal is turned on, reset the switches for the desired speed and parity and press the BREAK key to activate the change.

NOTE

If a character is received with a parity error when EVEN or ODD parity is selected, the character will be replaced on the display with a ? symbol.

c. Half or Full-Duplex

Full-Duplex

The forward position of this switch selects the full-duplex mode of communications which is typically used when the communications system is capable of simultaneous two-way transmission. In this mode, data entered from the keyboard is sent directly to the computer system. Upon reaching the computer, the data is typically "echoed" back to the Hazeltine 1400 screen at the discretion of the program (ie, it may not be desirable to echo back special codes, passwords, etc). If modems are used, they must be set for full-duplex operation. Only received or "echoed" data is displayed or acted upon.

Half-Duplex

The rear position of this switch selects the half-duplex mode of communications. In this mode, data entered from the keyboard is sent directly to the computer system and is treated as received data by the terminal via an internal connection. Echoing, as in full-duplex mode, is not required; if used, it would likely cause each transmitted character to be displayed twice.

d. Contrast Control

This control is located to the right of the switch array under the access panel. It allows a wide range of contrast to facilitate viewing ease of the high resolution display under various lighting conditions.

3.2 ALPHANUMERIC KEYS AND SPACE BAR

3.2.1 The alphanumeric keys cause transmission and display of the characters as marked. Where two markings appear on a key, the upper character is generated when keyed while the SHIFT key is held down in standard typewriter operation. Where only one character is marked on a key, the upper case letter will be generated without depression of the SHIFT key. The Hazeltine 1400 displays only upper case letters. If a lower case letter is received, it will be displayed as the corresponding upper case letter. The space bar generates a space character.

3.2.2 In addition to the displayable characters, any of the 128 ASCII codes can be transmitted by use of the CTRL (control) and SHIFT keys in conjunction with the alphanumeric keys. Appendix B lists all the ASCII codes and the corresponding key strokes. If the ASCII code represents a lower case letter, the corresponding upper case letter will be displayed. If the ASCII code represents a non-displayable character other than a lower case letter, nothing will be displayed. However, if the code represents one of the special functions described in the following paragraph, the terminal will perform the function.

3.3 SPECIAL FUNCTION KEYS

Table 3-1 lists the characters transmitted, and the operation performed, for each of the seven function keys on the keyboard, plus three additional functions for which no separate key is provided. An expanded description of each is given in the following paragraphs.

Table 3-1. Transmitted Characters in Half or Full-Duplex

Key Stroke	Transmitted Character(s)		Operation in half duplex or in full duplex if "echoed"
	Half Duplex	Full Duplex	
ESC (escape)	ESC	ESC	Lead-in
RUB OUT	DEL	DEL	Transmission only
RETURN	CR	CR	New line
LINE FEED	LF	LF	Cursor down*
CTRL P	DLE	DLE	Cursor right**
CTRL H	BS	BS	Cursor left
HOME	None	∿DC2	Home cursor
CLEAR	None	∿SUB	Clear screen
BREAK	Break signal	Break signal	Transmission only

See Appendix A for the ASCII code set

*See description
**Non destructive space

a. ESC (Escape)

When depressed, this key transmits the ESC code (ASCII ESC, column 1, row 11) which is commonly used to generate a program interrupt signal. It is also a valid lead-in for remote commands as described in paragraph 4.6.

b. Rub Out

When depressed, this key transmits a character of all "1" bits (ASCII DEL, column 7, row 15). The resulting interpretation depends on the software. It is commonly used to cancel the preceding character.

c. Return

When depressed, this key transmits the carriage return code (CR) and moves the cursor to the beginning of the next line. If the cursor is on the bottom line, scrolling occurs (see paragraph 4.4). If the previous entry was a line feed, the cursor moves to the beginning of the present line (see paragraph 4.5).

d. Line Feed

When depressed, this key transmits the line feed (LF) code and moves the cursor down one line. If the cursor is on the bottom line, scrolling occurs. Refer to paragraph 4.5 for a description of operation when a line feed character is received and when a line feed precedes or follows a carriage return.

e. Home

When depressed in half-duplex, this key causes the cursor to home to the first character position of the top row; nothing is transmitted. In full-duplex, the ~ (tilde) and DC2 codes are transmitted, and, when echoed back, cause the cursor to home.

f. Clear

When depressed (along with the SHIFT key) in half-duplex, this key causes the display to be cleared and the cursor to home; nothing is transmitted. In full-duplex, the ~ (tilde) and SUB codes are transmitted, and, when echoed back, cause the screen to be cleared and the cursor to home.

g. Break

Depressing this key generates a 200 to 250 millisecond break signal to the computer which is equivalent to the corresponding button on a conventional teletype terminal.

h. Cursor Right and Left Functions

Depressing the P key while the CTRL key is down causes the DLE code to be transmitted, and the cursor to move right one position. Its operation differs from the space bar in that it is a non-destructive space; ie, where entering a space replaces a character in the cursor position with a space, the cursor right function moves the cursor without changing the character

displayed. Similarly, depressing the H key while the CTRL key is down causes the back space (BS) code to be transmitted, and the cursor moves left one position.

i. Test Pattern

Typing a ∿ or ESC (lead-in) followed by CTRL S causes the test pattern, consisting of a full screen of O characters, to be displayed when in the half-duplex mode. In full-duplex, the DC3 code is transmitted, and, when echoed back, causes the test pattern to be displayed.

SECTION 4

OPERATION

4.1 INTRODUCTION

The basic mode of operation for the Hazeltine 1400 Video Display Terminal is character-by-character (switch setting at HALF or FULL-DUPLEX). Data which is entered via the keyboard is sent directly to the computer. A variety of remote commands (see Section 4.6) permit computer control of the format of displayed data.

4.2 OPERATION IN FULL-DUPLEX

The full-duplex mode of communication is typically used when the communication system is capable of simultaneous two-way transmission and permits more CPU control of the display. Data entered via the keyboard is routed directly to the computer without display. The display is comprised only of alphanumeric data "received" by or "echoed" back to the terminal. Each display function key (ie, HOME, CLEAR, etc) generates a code that is transmitted to the computer, and, under computer control, is "echoed" back to the terminal. The ASCII code for each of these display functions is included in paragraph 4.6.2.

4.3 OPERATION IN HALF-DUPLEX

The half-duplex mode of communication is used when the communication system is not capable of simultaneous two-way transmission, or the "echoed" back operation is undesirable. Data keyed from the keyboard is transmitted and displayed simultaneously. The data displayed is processed as if it were data transmitted by the computer. Display special function keys do not generate codes in half-duplex.

4.4 SCROLLING

If a displayable ASCII code is received at the last character position of the last displayable character row, the data moves up one row, the top row of data is removed, and the cursor

moves to the first character position (left margin) of the last (bottom) character row. Data from the last character row is replaced with spaces. This type of manipulation and cursor movement operation is referred to hereafter as scrolling and requires no fill characters at any baud rate. Scrolling also occurs when the cursor is on the bottom line and a line feed (ASCII LF) or carriage return (ASCII CR) is received.

4.5 CARRIAGE RETURN/LINE FEED

The Hazeltine 1400 provides a single-spaced display for both typewriter style and teletype style systems. When a carriage return is received, the cursor is advanced to the start of the next row (typewriter style new line function). When a carriage return and line feed are received together (in either order, ie, CR LF or LF CR) the cursor is also advanced to the start of the next row (teletype style). A line feed alone causes the cursor to move down one row, remaining in the same column. If double spacing is desired, it is necessary to use two carriage returns, or a carriage return and two line feeds. Operation when RETURN or LINE FEED are keyed is identical to operation when they are received.

4.6 REMOTE COMMANDS

4.6.1 General

The remote command features of the Hazeltine 1400 provide the user with the capability to control the terminal via the CPU software. For the terminal to execute a remote command, the command code must be preceded by a lead-in code (except as noted). The lead-in code may be either a tilde (ASCII ~, column 7, row 14; decimal 126) or an escape (ASCII ESC, column 1, row 11; decimal 27). The lead-in code is not displayed when received and does not advance the cursor. The command code must follow the lead-in without intervening characters (including NUL characters). If the code following the lead-in code is not one of the valid command codes requiring a lead-in, (a second lead-in is invalid), both the lead-in character and following character will be ignored.

4.6.2 Commands

a. Home Cursor (lead-in required)

On receipt of the HOME CURSOR command (ASCII DC2, column 1, row 2; decimal 18), the cursor moves to the upper left corner of the display (coordinates X=0, Y=0). This has no effect on data displayed.

b. Down Cursor (no lead-in required)

On receipt of the DOWN CURSOR command (ASCII LF, column 0, row 10; decimal 10), the cursor increments down one row without altering the display. If the cursor is located in the bottom row scrolling occurs.

c. Left Cursor (no lead-in required)

On receipt of the LEFT CURSOR command (ASCII BS, column 0, row 8; decimal 8), the cursor moves one character position to the left and does not alter the display. If the cursor is in the left-most column (X=0), it wraps backward to the row above and the right-most column (X=79). If the cursor is in the home position (X=Y=0), no cursor movement occurs.

d. Right Cursor (no lead-in required)

On receipt of the RIGHT CURSOR command (ASCII DLE, column 1, row 0; decimal 16), the cursor advances one character position to the right and does not alter the display (non-destructive space). The code is not stored in display memory. If the cursor is in the right-most column (X=79), it wraps around to the beginning of the following row. If the cursor is in column 79 of the bottom row there is no cursor movement upon receipt of the command.

e. Address Cursor (lead-in required)

On receipt of the ADDRESS CURSOR command (ASCII DC1, column 1, row 1; decimal 17), the cursor prepares to move to one of the character positions as defined by the command format below:

Lead-in Code	DC1	X	Y

The 80 character columns are designated X, and range from 0 to 79. The rows are designated Y, and range from 0 to 23.

The column addresses are decimal modulo 96 as follows:

Decimal Address	Column (X)
0 through 78	0 through 78
79 through 95	79
96 through 127	0 through 31 (decimal address -96)

The row addresses are decimal modulo 32 as follows:

Decimal Address	Row (Y)
0 through 22	0 through 22
23 through 31	23
32 through 54	0 through 22 (dec -32)
55 through 63	23
64 through 86	0 through 22 (dec -64)
87 through 95	23
96 through 118	0 through 22 (dec -96)
119 through 127	23

Appendix B lists all possible cursor addresses and the key strokes and ASCII codes for generating them.

f. Read Cursor Address (lead-in required)

On receipt of the READ CURSOR ADDRESS command (ASCII ENQ, column 0, row 5; decimal 5), the terminal responds with the cursor address. The X coordinate position is followed by the Y coordinate followed by a CR code. The X and Y coordinates transmitted can be found in Appendix B. The cursor position and the display are not altered. In the full-duplex mode of operation, the terminal is capable of receiving data during the transmission of the coordinates. In the half-duplex mode, the terminal is capable of receiving data after transmitting the CR code.

g. Clear Screen (lead-in required)

On receipt of the CLEAR SCREEN command (ASCII FS, column 1, row 12; decimal 28), the screen is cleared to spaces. The cursor moves to the home position (coordinates X=0, Y=0).

h. Keyboard Lock (lead-in required)

On receipt of the KEYBOARD LOCK command (ASCII NAK, column 1, row 5; decimal 21), the keyboard is inhibited. That is, data is not allowed to be entered on the screen from the keyboard. This mode is reset by a KEYBOARD UNLOCK command or by shutting power off and then on again.

i. Keyboard Unlock (lead-in required)

On receipt of the KEYBOARD UNLOCK command (ASCII ACK, column 0, row 6; decimal 6), the keyboard is enabled. That is, data is allowed to be entered on the screen from the keyboard. This is the initial state of the terminal.

j. Display Test Pattern (lead-in required)

On receipt of the DISPLAY TEST PATTERN command (ASCII DC3, column 1, row 3; decimal 19) the terminal displays a test pattern consisting of a full screen of O's, with the cursor in the home position.

k. Send Character (lead-in required)

On receipt of the SEND CHARACTER command (ASCII DC4, column 1, row 4; decimal 20) the terminal transmits the character at the present cursor position. The cursor is not advanced. When used in conjunction with the cursor left, cursor right and direct cursor address commands, this permits reading any character previously entered on the display.

SECTION 5

COMMUNICATIONS INTERFACE

5.1 ASCII

The Hazeltine 1400 terminal communicates with the ASCII code shown in Appendix A. A parity bit, as selected, is added to make an eight-bit code.

5.2 ASYNCHRONOUS DATA

The format for received and transmitted data is asynchronous serial ASCII. Each transmitted character is preceded by a start bit and followed by a stop bit. Received characters may have any number of stop bits. The parity bit can be selected (see Section 3) to be even, odd, always one, or always zero. If a character is received with incorrect parity (with odd or even parity selected), a question mark (?) is displayed on the screen at the cursor position. This indicates to the terminal operator that erroneous data was received. Switches are provided (see Section 3) to select one of eight transmission rates from 110 to 9600 baud.

Start Bit	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Parity Bit	Stop Bit	Stop Bit

TRANSMITTED DATA FORMAT

5.3 FULL DUPLEX/HALF DUPLEX

Full-duplex data communications facilities imply the ability for data communications in two directions simultaneously. For telecommunications, this means that the modem involved is capable of simultaneous bi-directional data transmission and reception. Full-duplex operation with the Hazeltine 1400 requires that communications take place at the same baud rate for both receive and transmit. Half-duplex communications facilities imply that data communications alternate between receive and transmit. For telecommunications, this means that the modem involved is controlled by the terminal as to whether it is in a transmitting state or a receiving state.

5.4 EIA INTERFACE

The standard EIA connector located on the rear of the terminal provides the connection to the appropriated data set or acoustic coupler. The signals conform to EIA standard RS-232C and are listed below:

Number	Direction of Signal	Designation	Function
1	--	AA	Protective Ground (Chassis)
2	From Terminal	BA	Transmitted Data
3	To Terminal	BB	Received Data
4	From Terminal	CA	Request to Send
5	To Terminal	CB	Clear to Send
6	To Terminal	CC	Data Set Ready
7	--	AB	Signal Ground
8	To Terminal	CF	Data Carrier Detect
13	From Terminal	--	16X Clock (TTL Level)
18	From Terminal	--	Current Loop Adapter Voltage Source
20	From Terminal	CD	Data Terminal Ready
23*	From Terminal	CH-CI	2400 Baud Select

*Export Models Only

5.5 HARD WIRED INTERFACE

The Hazeltine 1400 can be connected directly to a computer by connecting pins 1, 2, and 3 from the input/output connector on the rear panel. Note that pins 2 and 3 must be crossed with the corresponding pins on the computer. No wiring changes are required at the terminal to simulate the presence of a modem. Refer to your computer supplier for any special wiring at the computer interface.

5.6 DATA SETS

5.6.1 103A Modem

The Hazeltine 1400 connects directly to a 103A modem through an optional interface cable which is available through your Hazeltine representative.

5.6.2 202 Modem Half-Duplex Operation

The Hazeltine 1400 connects to a 202 modem as specified for the 103A. The following procedure should be followed for proper operation with a half-duplex 202 modem.

a. Upon depression of the first key, the Hazeltine 1400 conditions the modem for transmission by raising the EIA request to send output. This can take up to 1/5 of a second. A very fast typist should take care to ensure that the first character reaches the screen before additional entries are made.

b. To complete the transmission to the computer system, either a carriage return (RETURN), ETX (CTRL C) or EOT (CTRL D) should be entered. The termination character used is determined by the computer software. Upon sending the termination character, the 202 modem switches into the receive mode under control of the EIA request to send signal.

c. The depression of the next character key returns operation to step a.

SECTION 6

SERVICING

6.1 INTRODUCTION

This section provides instructions for gaining access to internal components, changing the fuse, removing and replacing the printed circuit board, and aligning the monitor circuits. Contact Hazeltine Sales Representative for information on spares and service beyond user capability.

6.2 ACCESS

To gain access to internal components proceed as follows:

WARNING

Dangerous voltages (12,000 vdc, 500 vdc and 115 vac) are present in the Video Display Terminal. Some voltage may remain present in the monitor circuits after power is removed. Use caution when working on internal circuits. Do not work alone.

a. Disconnect the power cord plug from the ac power socket.

b. Lay the terminal on its side and loosen two captive screws in the base (figure 6-1).

c. Set the terminal upright and loosen two captive screws at the top rear.

d. Carefully lift the cover and cathode-ray tube (crt) off the base and immediately to the right. There is enough slack in the wiring to lay the cover on its side alongside the base as shown in figure 6-2. ~~The terminal may be turned on and operated in this condition for alignment or troubleshooting purposes.~~ The terminal cannot be turned on with the cover removed.

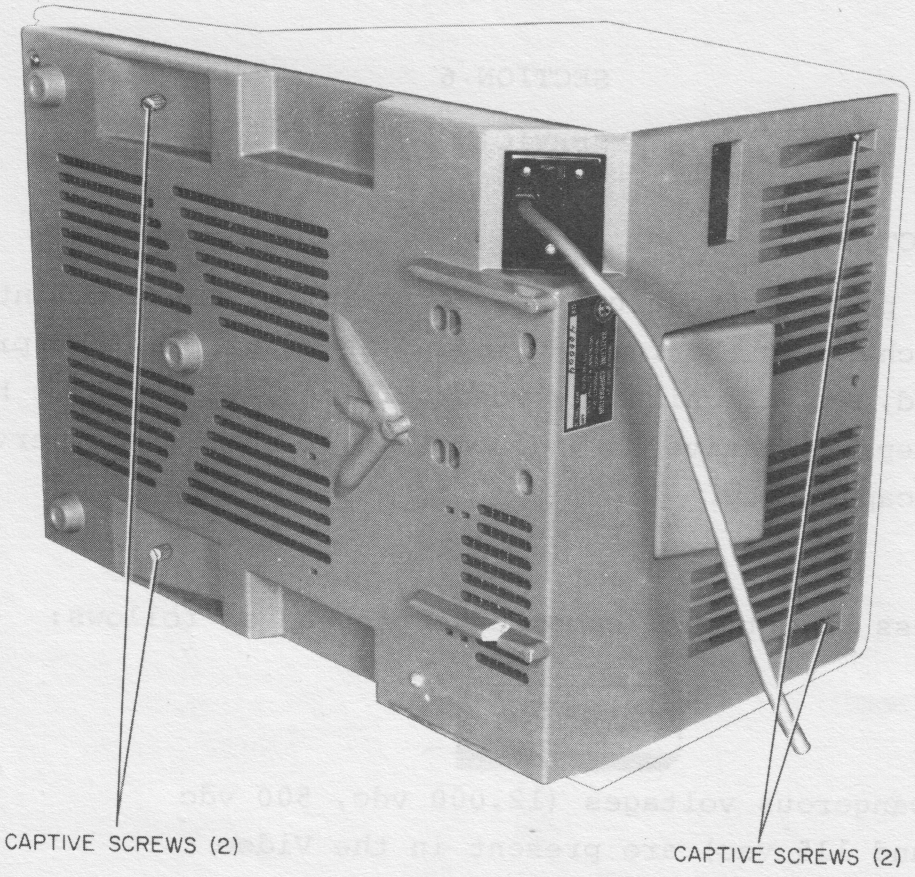


Figure 6-1. 1400 Terminal, Rear and Bottom View

6.3 CHANGING FUSE

NOTE

If the terminal does not operate at all, look through the slots in the rear to see if the crt filaments are lit. If they are lit, the problem is not a blown fuse.

a. Open the unit as described in paragraph 6.2.

b. Loosen two screws securing circuit board to base (figure 6-3).

c. Grasp the circuit board under the keyboard area and lift up about 1/2 inch; then slide the circuit board forward just enough for the keyhole slots to clear the screw head, and lift the board gently from the base.

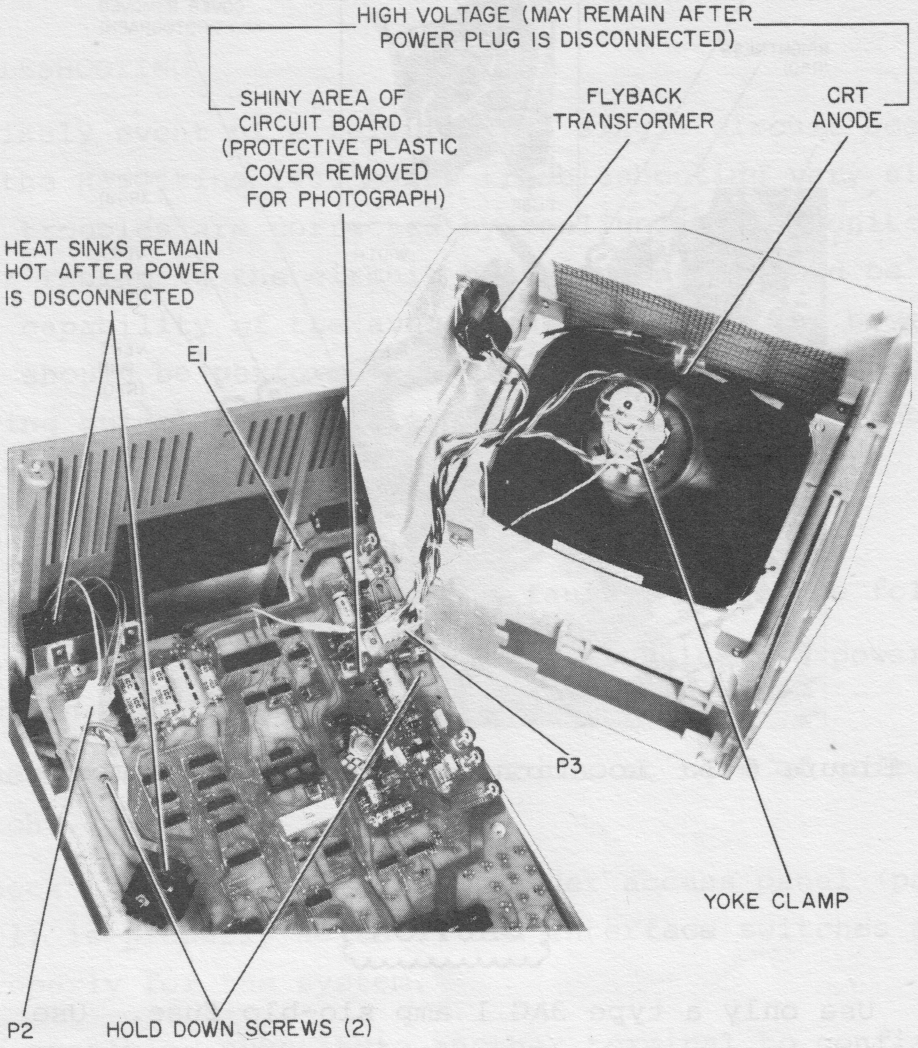


Figure 6-2. 1400 Terminal, Open, Ready for Servicing

WARNING

Double check that the power cord is disconnected before changing fuse.

d. The fuse is located on a bracket assembly at the right rear of the base (figure 6-3). It may be removed by pulling up by hand, or with a fuse puller tool available in most automotive shops.

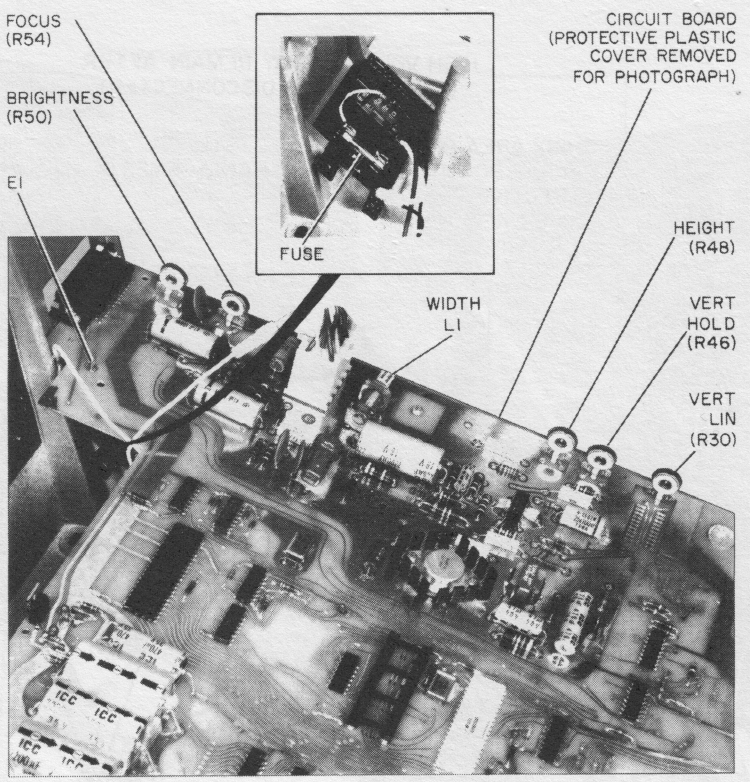


Figure 6-3. Location of Fuse and Adjustments

CAUTION

Use only a type 3AG 1 amp slo-blo fuse. Use of a larger fuse may cause damage to the terminal.

e. Install the new fuse by pressing into the clamps.

f. Slide circuit board onto the base and seat the holes in the board over the bosses on the base.

g. Secure the board with the two screws removed in step b.

h. ~~Connect the power cable and set the power switch to ON~~. Place the cover on the base, set power switch to on. If the replacement fuse blows, the terminal is defective.

i. Disconnect the power cord. If the replacement fuse has not blown, reassemble the unit by reversing the procedure of paragraph 6.2. If the replacement fuse blows, no further user servicing is possible; the circuit board must be exchanged or professionally repaired.

6.4 TROUBLESHOOTING

In the unlikely event of a failure, the single circuit board design of the Hazeltine 1400 makes troubleshooting very simple. Almost all troubles are corrected by realigning the monitor circuits or replacing the circuit board. These should be within the capability of the average user. Servicing beyond this level should be performed only by a qualified technician. The following guidelines are provided to help isolate problems and minimize unnecessary replacement of circuit boards.

6.4.1 Preliminary Steps

Before deciding that the terminal is faulty, check the following:

- o Power cord plugged into a working outlet and power switch ON.
- o Check that input/output connector at rear of unit is tight.
- o Check that CONTRAST control under access panel (paragraph 3.1) is properly adjusted and interface switches are set properly for the system.
- o If possible, substitute another terminal to confirm or absolve the terminal (versus interface) as the cause of the problem.

6.4.2 Troubleshooting Procedure

a. Unplug and open the unit as described in paragraph 6.2.

b. Refer to table 6-1 and answer the questions about the symptoms. The chart will lead you through the appropriate troubleshooting steps.

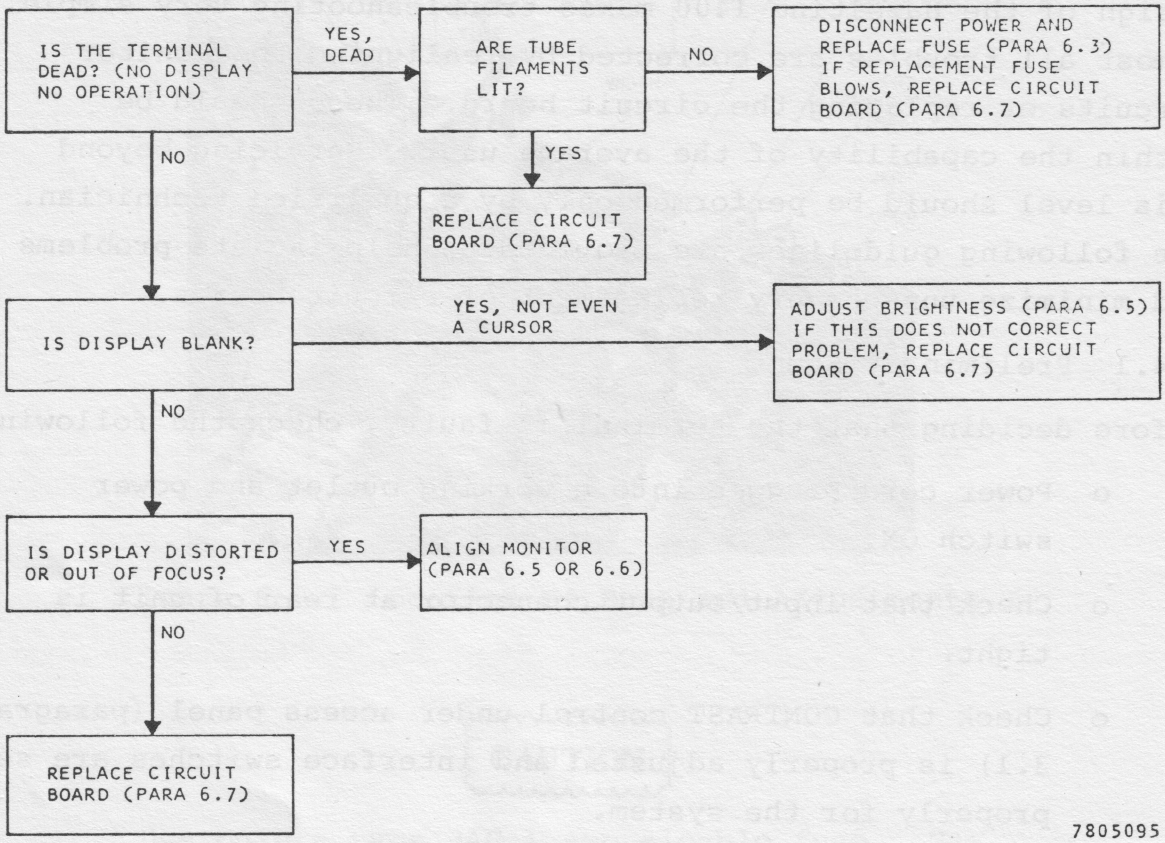
6.5 TOUCH UP ALIGNMENT

a. Connect the power cord and set the power switch to ON.

b. Set the HALF/FULL duplex switch for HALF duplex.

c. Type BREAK ESC ^{c}S. A full screen of Os should be displayed.

Table 6-1. Troubleshooting Chart



d. Find the problem(s) in the left column below, and adjust the control listed in the right column to correct the problem.

CAUTION

Do not use a metal tool to make adjustments.

Problem (See figure 6-4)	Adjustment (See figure 6-5)
Display too dark or too bright	BRIGHTNESS (R50)
Display out of focus	FOCUS (R54)
Display too wide or too narrow	WIDTH (L1) (Norm is 8-1/2 in.)
Display too high or not high enough	HEIGHT (R48) (Norm is 5-3/4 in.)
Display rolls or part of top or bottom character row missing	V HOLD (R46)
Some character rows larger or smaller than others	V LIN (R30)

6.6 COMPLETE ALIGNMENT

Only the touch up alignment procedure given in paragraph 6.5 should be needed in normal service. However, if a circuit board or crt is replaced and complete realignment is required, follow the procedure below:

a. Connect thepower cord and set the power switch to ON.

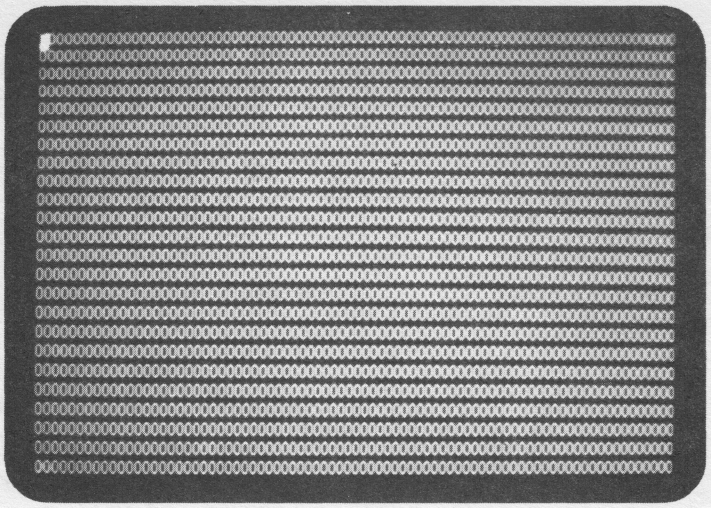
b. Set the HALF/FULL duplex switch for HALF duplex.

c. Type BREAK ESC ^{C}S.

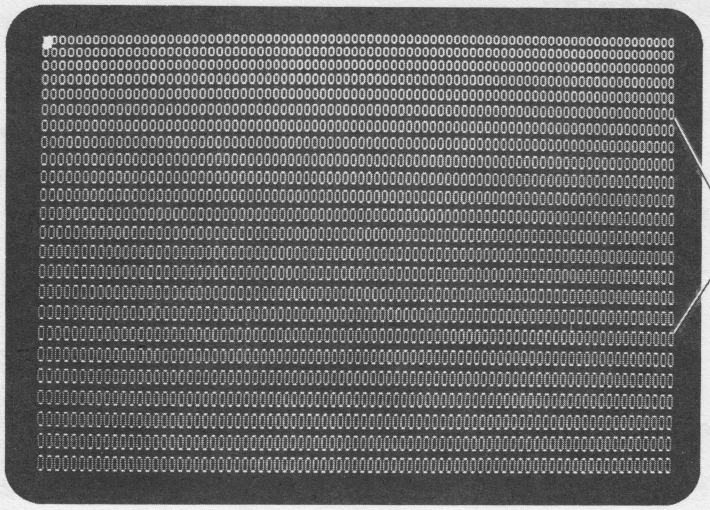
d. Adjust BRIGHTNESS control R50 (see figure 6-5 for locations) until a raster is just visible on the screen (fine horizontal lines just brighter than the background).

e. Adjust BRIGHTNESS control R50 until the raster just disappears (background lines cannot be seen).

f. If the display is tilted, perform steps (1) through (5). Otherwise skip to step g.

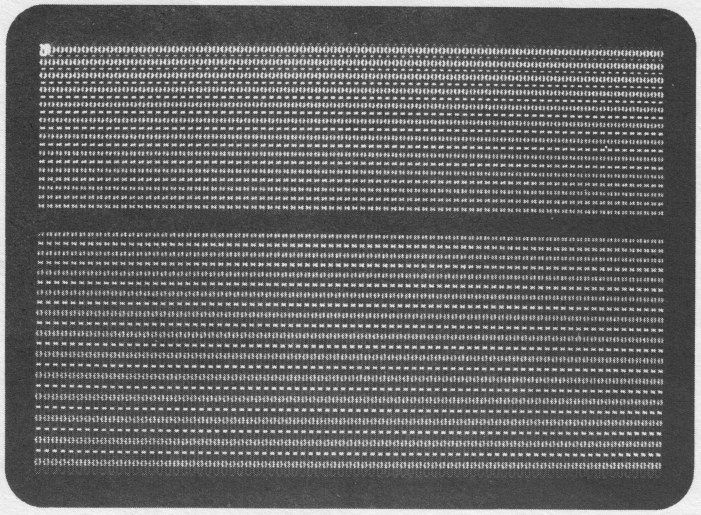


OUT OF FOCUS
ADJUST "FOCUS"



SOME ROWS
MUCH LARGER
OR SMALLER
THAN OTHERS

ADJUST
"VERT LIN"



DISPLAY ROLLS
UP OR DOWN
ADJUST "V HOLD"

Figure 6-4. Display Faults

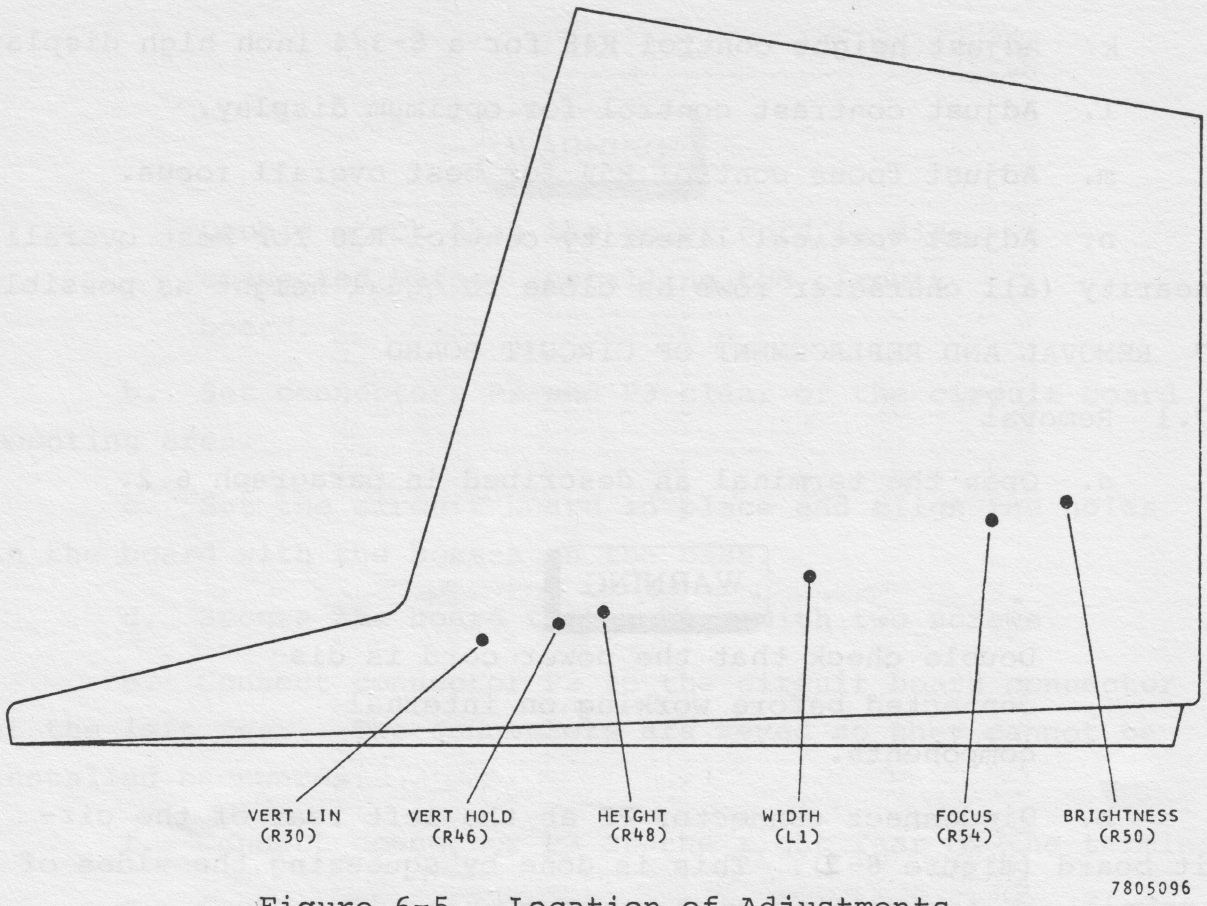


Figure 6-5. Location of Adjustments

(1) Note the direction and amount of tilt.

(2) Disconnect the power plug and open the unit as described in paragraph 6.2.

(3) Loosen the screw securing the clamp on the neck of the tube (figure 6-2).

(4) Rotate the yoke in the direction and distance necessary to correct the tilt noted in step (1) and tighten the screws. (The display will rotate the same distance and direction as the yoke is rotated).

(5) ~~Set the power switch to ON and check the display~~ Place cover on the base, set power switch to on, and check display. Repeat steps (1) through (4) if necessary.

(6) Set the power switch to off and reassemble the unit by reversing the procedure of paragraph 6.2.

g. If display is rolling up or down, adjust vert hold potentiometer R46 until display is steady.

k. Adjust height control R48 for a 5-3/4 inch high display.

l. Adjust contrast control for optimum display.

m. Adjust focus control R54 for best overall focus.

n. Adjust vertical linearity control R30 for best overall linearity (all character rows as close to equal height as possible).

6.7 REMOVAL AND REPLACEMENT OF CIRCUIT BOARD

6.7.1 Removal

a. Open the terminal as described in paragraph 6.2.

WARNING

Double check that the power cord is disconnected before working on internal components.

b. Disconnect connector P2 at the left rear of the circuit board (figure 6-3). This is done by squeezing the sides of the connector to release the latch and pulling straight up.

c. Disconnect P3 at the right rear of the circuit board in the same manner.

d. Disconnect the single green wire from terminal E1 of the circuit by pulling straight up on the metal clip; do not pull on the wire itself.

e. Remove the two screws securing the board to the base.

f. Grasp the circuit board under the keyboard area and lift about 1/2 inch, then remove the board by sliding straight forward.

6.7.2 Replacement

a. Set the HALF/FULL duplex switch to HALF (see Section 3).

WARNING

Double check that the power cord is disconnected before installing the circuit board.

b. Set connectors P2 and P3 clear of the circuit board mounting area.

c. Set the circuit board in place and align the holes in the board with the bosses on the base.

d. Secure the board to the base with two screws.

e. Connect connector P2 to the circuit board connector at the left rear. The connectors are keyed so they cannot be installed backwards.

f. Connect connector P3 at the right rear of the terminal.

g. Connect the single green wire to terminal E1 (figure 6-3) by pressing the clip onto the terminal.

h. Connect the power cord and set the power switch to ON. Check that the cursor is displayed on the screen within 3 minutes.

Make P3 is in J3. Damage may result otherwise

NOTE

It may be necessary to adjust the BRIGHTNESS control (figure 6-5) in order to see the display.

i. Type BREAK ESC ^{C}S. A full screen of Os should be displayed.

j. Check the display for focus and distortion. If minor distortion is present, refer to paragraph 6.5 and adjust as required. If major distortion is present, perform the alignment procedure described in paragraph 6.6.

k. When a satisfactory display is obtained, disconnect the power cord and reassemble the terminal by reversing the procedure of paragraph 6.2.

SECTION 7

TECHNICAL SUMMARY

DISPLAY FORMAT	
Screen	12 inch (30.5 cm) diagonal, P4 phosphor (gray)
Capacity	80 characters/line x 24 lines (1920 characters)
Character Format	5 x 7 dot matrix in 7 x 10 dot window white display on black background
Cursor	Block cursor. Character shows through cursor in reverse video when superimposed
Character Set	64 displayable ASCII (upper case alphabet). All 128 ASCII codes can be keyed
Refresh Rate	60 Hz, no interlace
TV Line Standard	260 lines/frame, 240 lines displayed
Memory	2048 x 8 Random Access Memory
INTERFACE	
Input/Output	EIA RS-232C
Transmission Rates	110, 300, 600, 1200, 1800, 2400, 4800, 9600 baud (switch selected)
Parity	Odd, Even, 1 or 0 (switch selected)
Character	Eleven bits (start, seven bit ASCII, parity, two stop bits). Received characters may have any number of stop bits.
Modes	Half-duplex or full-duplex (switch selected)
PHYSICAL/ENVIRONMENTAL DATA	
Size	15-1/2 inches (39.4 cm) wide, 13-1/2 inches (34.3 cm) high, 20-1/2 inches (52.2 cm) deep
Weight	28 pounds (12.7 kg)
Power Required	104 to 126 v, 60 Hz ±1%, 75 watts
Temperature Range	10° to 40°C (50° to 104°F) operating; -20° to 65°C (4° to 150°F) storage
Humidity Range	5% to 90%, non-condensing
ADDITIONAL FEATURES	
Break Key	Inserts 200 to 250 ms break in transmitted data
Built-In Test	Automatic Self-test at turn on
Test Pattern	TV test pattern, operator or remotely selected
Remote Commands	Cursor down, right, left, home Direct cursor address, send cursor address Clear screen Keyboard lock, unlock Display test pattern Send character at current cursor position

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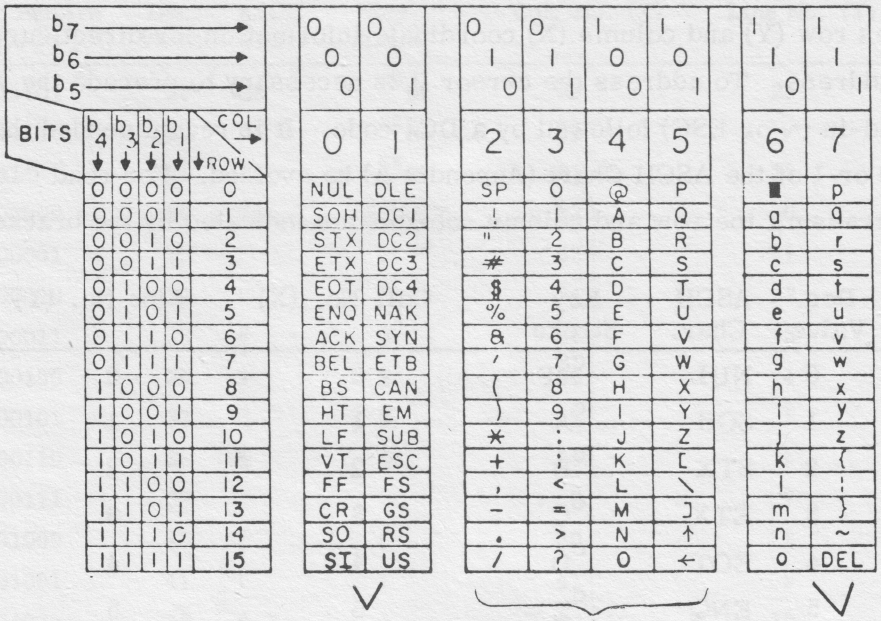
APPENDIX A

ASCII CHARACTER CODE CHART



*Received lower case characters are displayed as upper case.

**The following control codes have the indicated significance to the Hazeltine 1400. All others are ignored.

CODE	FUNCTION	
CR	New Line (Carriage Return)	
LF	Cursor Down (Line Feed)	
DLE	Cursor Right	
BS	Cursor Left	
ESC	Remote Command Lead-In	
DC4	Send Character	Lead-In Required
DC2	Cursor Home	
DC1	Address Cursor	
ENQ	Read Cursor Address	
FS	Clear Screen	
NAK	Keyboard Lock	
ACK	Keyboard Unlock	
DC3	Display Test Pattern	

APPENDIX B

CURSOR ADDRESS CHART

This table provides row (Y) and column (X) coordinate information for direct cursor address and read cursor address. To address the cursor it is necessary to precede the X and Y coordinates by a lead-in (~ or ESC) followed by a DC1 code. It is recommended that use of codes in column 0 or 1 of the ASCII Chart (Appendix A) be avoided. For read cursor address the terminal will transmit the row and column coordinates indicated by the brackets.

Bit Pattern b_7 ..... b_1	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)	Line No. (Y)
0000000	0	NUL	^{cs}P	0	0
0000001	1	SOH	^{c}A	1	1
0000010	2	STX	^{c}B	2	2
0000011	3	ETX	^{c}C	3	3
0000100	4	EOT	^{c}D	4	4
0000101	5	ENQ	^{c}E	5	5
0000110	6	ACK	^{c}F	6	6
0000111	7	BEL	^{c}G	7	7
0001000	8	BS	^{c}H	8	8
0001001	9	HT	^{c}I	9	9
0001010	10	LF	LINE FEED	10	10
0001011	11	VT	^{c}K	11	11
0001100	12	FF	^{c}L	12	12
0001101	13	CR	RETURN	13	13
0001110	14	SO	^{c}N	14	14
0001111	15	SI	^{c}O	15	15
0010000	16	DLE	^{c}P	16	16
0010001	17	DC1	^{c}Q	17	17
0010010	18	DC2	^{c}R	18	18
0010011	19	DC3	^{c}S	19	19
0010100	20	DC4	^{c}T	20	20
0010101	21	NAK	^{c}U	21	21
0010110	22	SYN	^{c}V	22	22
0010111	23	ETB	^{c}W	23	23
0011000	24	CAN	^{c}X	24	23
0011001	25	EM	^{c}Y	25	|
0011010	26	SUB	^{c}Z	26	|
0011011	27	ESC*	ESC	27	|
0011100	28	FS	^{cs}L	28	23

CURSOR ADDRESS CHART (Cont)

Bit Pattern $b_7 \ldots b_1$	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)		Line No. (Y)
0011101	29	GS	^{cs}M	29		23
0011110	30	RS	^{cs}N	30		|
0011111	31	US	^{cs}O	31		23
0100000	32	SP	SPACE	32		0
0100001	33	!	!	33		1
0100010	34	"	"	34		2
0100011	35	#	#	35		3
0100100	36	$	$	36		4
0100101	37	%	%	37		5
0100110	38	&	&	38		6
0100111	39	'	'	39		7
0101000	40	(	(	40		8
0101001	41	)	)	41		9
0101010	42	*	*	42		10
0101011	43	+	+	43		11
0101100	44	,	,	44		12
0101101	45	-	-	45		13
0101110	46	.	.	46		14
0101111	47	/	/	47		15
0110000	48	0	0	48		16
0110001	49	1	1	49	Output	17
0110010	50	2	2	50	Read	18
0110011	51	3	3	51	Cursor	19
0110100	52	4	4	52	Address	20
0110101	53	5	5	53		21
0110110	54	6	6	54		22
0110111	55	7	7	55		23
0111000	56	8	8	56		23
0111001	57	9	9	57		|
0111010	58	:	:	58		|
0111011	59	;	;	59		|
0111100	60	<	<	60		|
0111101	61	=	=	61		|
0111110	62	>	>	62		|
0111111	63	?	?	63		23
1000000	64	@	@	64		0
1000001	65	A	A	65		1
1000010	66	B	B	66		2
1000011	67	C	C	67		3

CURSOR ADDRESS CHART (Cont)

Bit Pattern $b_7 \ldots b_1$	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)		Line No. (Y)	
1000100	68	D	D	68		4	
1000101	69	E	E	69		5	
1000110	70	F	F	70		6	
1000111	71	G	G	71		7	
1001000	72	H	H	72	Output Read Cursor Address	8	
1001001	73	I	I	73		9	
1001010	74	J	J	74		10	
1001011	75	K	K	75		11	
1001100	76	L	L	76		12	
1001101	77	M	M	77		13	
1001110	78	N	N	78		14	
1001111	79	O	O	79		15	
1010000	80	P	P	79		16	
1010001	81	Q	Q			17	
1010010	82	R	R			18	
1010011	83	S	S			19	
1010100	84	T	T			20	
1010101	85	U	U			21	
1010110	86	V	V			22	
1010111	87	W	W			23	
1011000	88	X	X			23	
1011001	89	Y	Y				
1011010	90	Z	Z				
1011011	91	[	[				
1011100	92	\	\				
1011101	93	]	]				
1011110	94	^	↑				
1011111	95	_	←	79		23	
1100000	96	`	^{c}SPACE	0		0	
1100001	97	a	$^{cs}_{1}$	1		1	
1100010	98	b	$^{cs}_{2}$	2		2	
1100011	99	c	$^{cs}_{3}$	3	Output Read Cursor Address	3	Output Read Cursor Address
1100100	100	d	$^{cs}_{4}$	4		4	
1100101	101	e	$^{cs}_{5}$	5		5	
1100110	102	f	$^{cs}_{6}$	6		6	
1100111	103	g	$^{cs}_{7}$	7		7	
1101000	104	h	$^{cs}_{8}$	8		8	
1101001	105	i	$^{cs}_{9}$	9		9	
1101010	106	j	$^{cs}_{:}$	10		10	
1101011	107	k	$^{cs}_{;}$	11		11	

CURSOR ADDRESS CHART (Cont)

Bit Pattern $b_7 \ldots b_1$	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)		Line No. (Y)	
1101100	108	l	c,	12		12	
1101101	109	m	c-	13		13	
1101110	110	n	c.	14		14	
1101111	111	o	c/	15		15	
1110000	112	p	c_0	16		16	Output Read Cursor Address
1110001	113	q	c_1	17	Output Read Cursor Address	17	
1110010	114	r	c_2	18		18	
1110011	115	s	c_3	19		19	
1110100	116	t	c_4	20		20	
1110101	117	u	c_5	21		21	
1110110	118	v	c_6	22		22	
1110111	119	w	c_7	23		23	
1111000	120	x	c_8	24		23	
1111001	121	y	c_9	25			
1111010	122	z	c:	26			
1111011	123	{	c;	27			
1111100	124	¦	cs,	28			
1111101	125	}	cs-	29			
1111110	126	~*	cs.	30			
1111111	127	DEL	RUBOUT	31		23	

*Lead-in Code

CURSOR ADDRESS CHART (Cont)

Bit Pattern $b_7 \ldots b_1$	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)		Line No. (Y)	
1000100	68	D	D	68		4	
1000101	69	E	E	69		5	
1000110	70	F	F	70		6	
1000111	71	G	G	71		7	
1001000	72	H	H	72	Output Read Cursor Address	8	
1001001	73	I	I	73		9	
1001010	74	J	J	74		10	
1001011	75	K	K	75		11	
1001100	76	L	L	76		12	
1001101	77	M	M	77		13	
1001110	78	N	N	78		14	
1001111	79	O	O	79		15	
1010000	80	P	P	79		16	
1010001	81	Q	Q			17	
1010010	82	R	R			18	
1010011	83	S	S			19	
1010100	84	T	T			20	
1010101	85	U	U			21	
1010110	86	V	V			22	
1010111	87	W	W			23	
1011000	88	X	X			23	
1011001	89	Y	Y				
1011010	90	Z	Z				
1011011	91	[	[				
1011100	92	\	\				
1011101	93	]	]				
1011110	94	^	↑				
1011111	95	_	←	79		23	
1100000	96	`	^{c}SPACE	0		0	
1100001	97	a	$^{cs}1$	1		1	
1100010	98	b	$^{cs}2$	2		2	
1100011	99	c	$^{cs}3$	3	Output Read Cursor Address	3	Output Read Cursor Address
1100100	100	d	$^{cs}4$	4		4	
1100101	101	e	$^{cs}5$	5		5	
1100110	102	f	$^{cs}6$	6		6	
1100111	103	g	$^{cs}7$	7		7	
1101000	104	h	$^{cs}8$	8		8	
1101001	105	i	$^{cs}9$	9		9	
1101010	106	j	^{cs}:	10		10	
1101011	107	k	^{cs};	11		11	

CURSOR ADDRESS CHART (Cont)

Bit Pattern $b_7 \ldots b_1$	Dec. Value	ASCII Char.	Key Stroke	Col. No. (X)		Line No. (Y)	
1101100	108	l	c,	12		12	
1101101	109	m	c-	13		13	
1101110	110	n	c.	14		14	
1101111	111	o	c/	15		15	
1110000	112	p	c_0	16		16	Output Read Cursor Address
1110001	113	q	c_1	17	Output Read Cursor Address	17	
1110010	114	r	c_2	18		18	
1110011	115	s	c_3	19		19	
1110100	116	t	c_4	20		20	
1110101	117	u	c_5	21		21	
1110110	118	v	c_6	22		22	
1110111	119	w	c_7	23		23	
1111000	120	x	c_8	24		23	
1111001	121	y	c_9	25			
1111010	122	z	c:	26			
1111011	123	{	c;	27			
1111100	124	|	cs,	28			
1111101	125	}	cs-	29			
1111110	126	~*	cs.	30			
1111111	127	DEL	RUBOUT	31		23	

*Lead-in Code

APPENDIX C
PROGRAMMING EXAMPLE

The following subroutine is written in basic for cursor addressing on the Hazeltine 1400. It is provided only as an example, and will probably require modification to accommodate differences in syntax for particular systems. This subroutine converts decimal values of x and y coordinates to their ASCII equivalent and sends the cursor address function to the terminal.

```
200     REM :::::::::CURSOR ADDRESS SUBROUTINE:::::::::
201     REM   INPUT VARIABLES ARE A(3) = X COORD;  A(4) = Y COORD;
202     REM   B(0) = MAX. LINE NO. (11 OR 23)
203     REM ROUTINE ENDS BY POSITIONING CURSOR AT DEFINED SCREEN ADDR.
204     DIM A(4)
205     DIM B(1)
206     A(0) = 4
207     A(1) = 126
208     A(2) = 17
209     A1$ = ""
210     IF A(3) <80 GOTO 220
211     PRINT "CUR. ADDR. VALUE >79 ENTERED AS X COORD";A(3);
215     A1$ = "ERROR"
217     B(1) = B(0) + 1
220     IF A(4) <B(1) GOTO 232
225     PRINT "CUR. ADDR. VALUE >";B(0);"ENTERED AS Y COORD";A(4);
230     A1$ = "ERROR"
232     IF A1$ = "ERROR" GOTO 260
236     C2 = A(3)
238     C1 = A(4)
239     IF A(3) >30 GOTO 245
240     A(3) = A(3) + 96
245     A(4) = A(4) + 96
250     CHANGE A TO A$
255     PRINT A$;
257     A(3) + C2
259     A(4) + C1
260     RETURN
```

Example of coding to utilize cursor address subroutine:

```
- - - - -
- - - - -
A(3) = 10
A(4) = 7
B(0) = 23
GOSUB 200
PRINT "I AM THE HAZELTINE 1400"
```

The prior example will display I AM THE HAZELTINE 1400 on line seven starting at column ten.

APPENDIX D

SUMMARY OF REMOTE COMMANDS

REMOTE COMMAND	LEAD IN	KEYSTROKE	ALT	ASCII CODE	DECIMAL
Home Cursor	Yes	HOME	^{C}R	DC2	18
Cursor Down	No	LINE FEED	^{C}K	VT	11
Cursor Right	No	^{C}P		DLE	16
Cursor Left	No	^{C}H		BS	8
Address Cursor	Yes	^{C}Q		DC1, x, y	17, x, y
Read Cursor Address	Yes	^{C}E		ENQ	5
Clear Screen	Yes	CLEAR	^{CS}L	FS	28
Keyboard Lock	Yes	^{C}U		NAK 21	21
Keyboard Unlock	Yes	^{C}F		ACK	6
Display Test Pattern	Yes	^{C}S		DC3	19
Send Character	Yes	^{C}T		DC4	20

NOTES:

Lead-in may be ASCII ~ (Decimal 126) or ASCII ESC (Decimal 27)

Cursor Addresses are listed in Appendix B

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